

EPS-Loop: Recycling of EPS-waste

EPS-Loop

Recycling of EPS-waste to expandable polystyrene

Dr. Andreas Mäurer und **Dr.-Ing. Udo Knauf**
Fraunhofer-Institut für Verfahrenstechnik und Verpackung, IVV
Giggenhauser Str. 35, 85354 Freising, Germany
E-mail: am@ivv.fhg.de

FAKUMA Forum 2005
Friedrichshafen, 20. Oktober 2005

EPS-Loop: Recycling of EPS-waste

Content

1. EPS - waste status
2. CreaSolv®-Process
3. EPS-Loop project work
4. Technical results
5. Summary



EPS-Loop: Recycling of EPS-waste

1. EPS-waste status

- EPS contains 98% air. This is the reason for large volumes and low weight are transported at high cost.
- Collected EPS is grinded to be used in porous bricks or to create holes in concrete parts to improve insulating properties.
- Low product quality caused by impurities (and/or other plastics).
- No robust and profitable technology for food packaging (fish & meat).
- Compressing during collection and extrusion to transportable granulates thermally degrades the plastic.

Projekt goals:

- Volume reduction for collection and transport
- Re- expandable recycled polystyrene

EPS-Loop: Recycling of EPS-waste

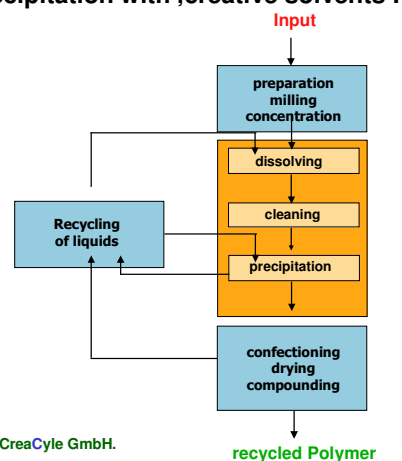
Recycling makes sense for...

Sellable recycled plastics
accepted in the market place

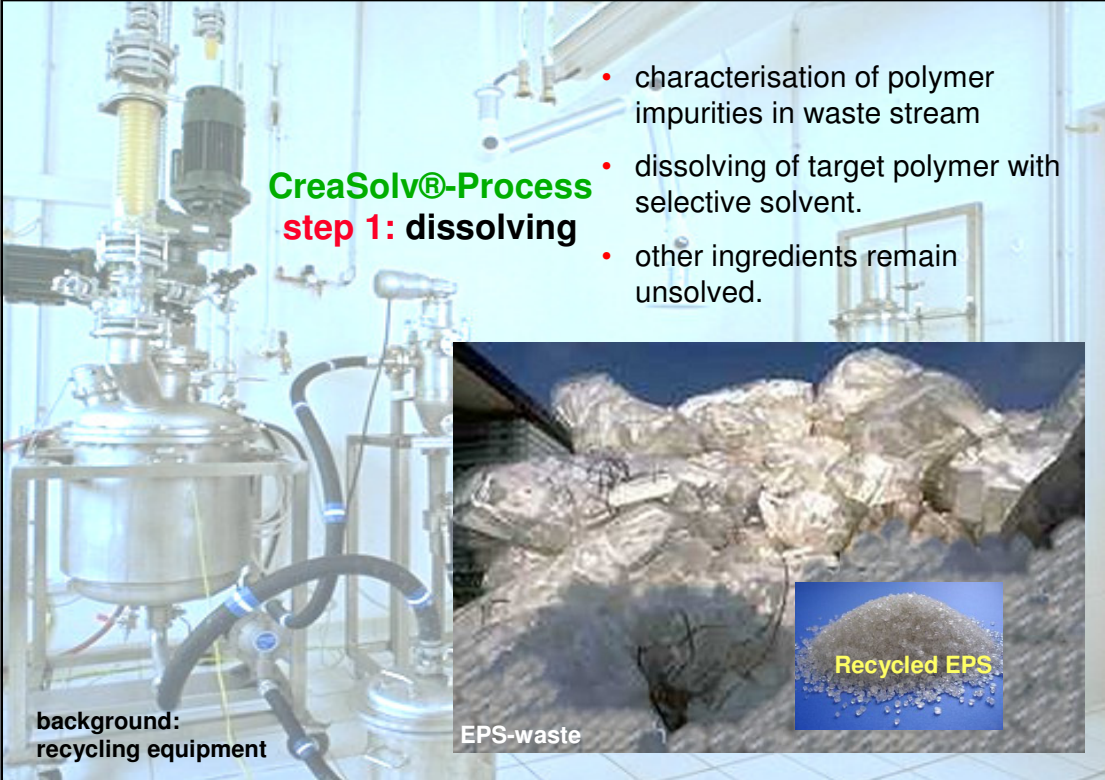
- free of contamination
 - national and EU-Direktivee
 - Commitment
- free of other polymers
- Specification of virgin product
 - Rheology
 - Mechanical properties
 - Optical properties

2. CreaSolv®-Process

Selektive dissolving, cleaning and
precipitation with ‚creative solvents‘.




CreaSolv® is a registered trademark of CreaCyle GmbH.




CreaSolv®-Process
step 1: dissolving

- characterisation of polymer impurities in waste stream
- dissolving of target polymer with selective solvent.
- other ingredients remain unsolved.

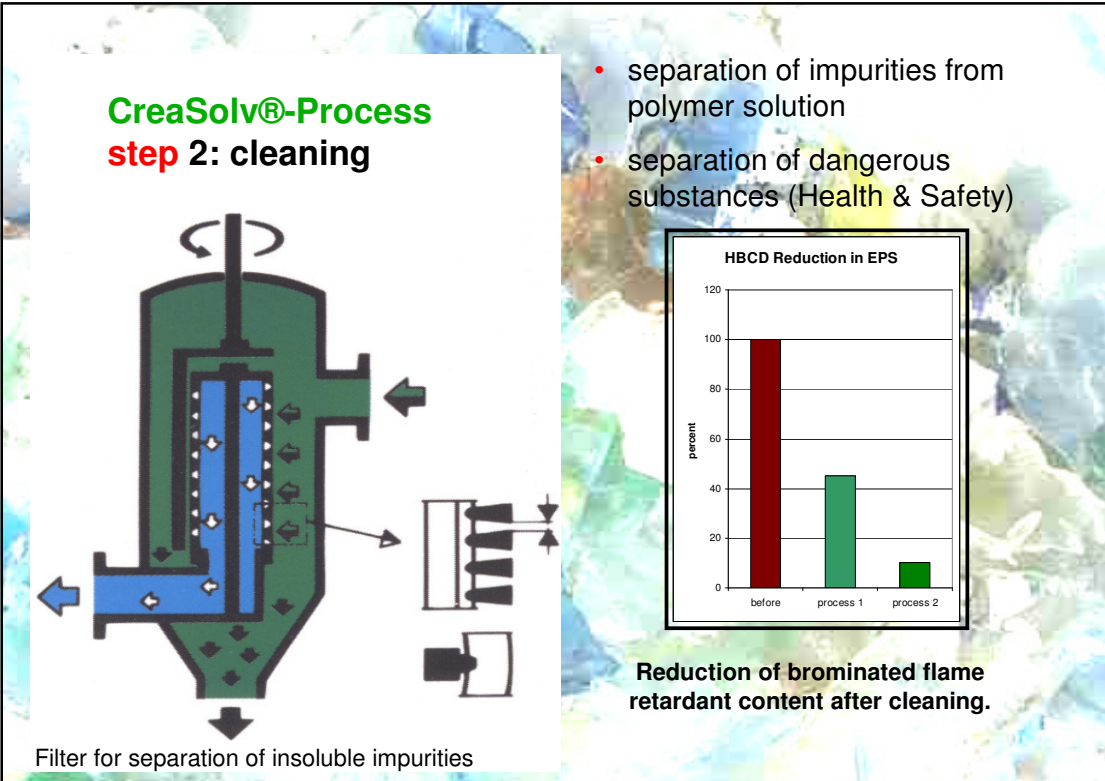
background:
recycling equipment



EPS-waste

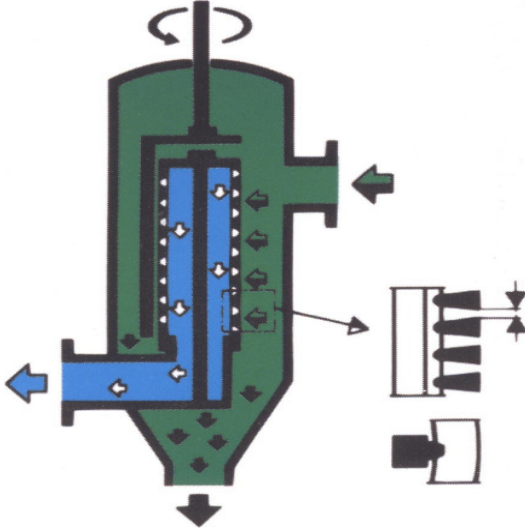


Recycled EPS

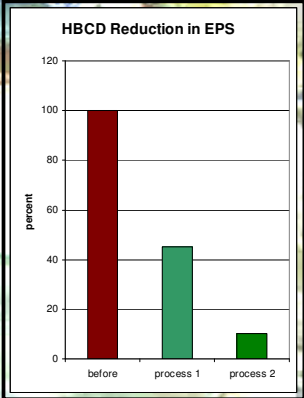


CreaSolv®-Process
step 2: cleaning

- separation of impurities from polymer solution
- separation of dangerous substances (Health & Safety)

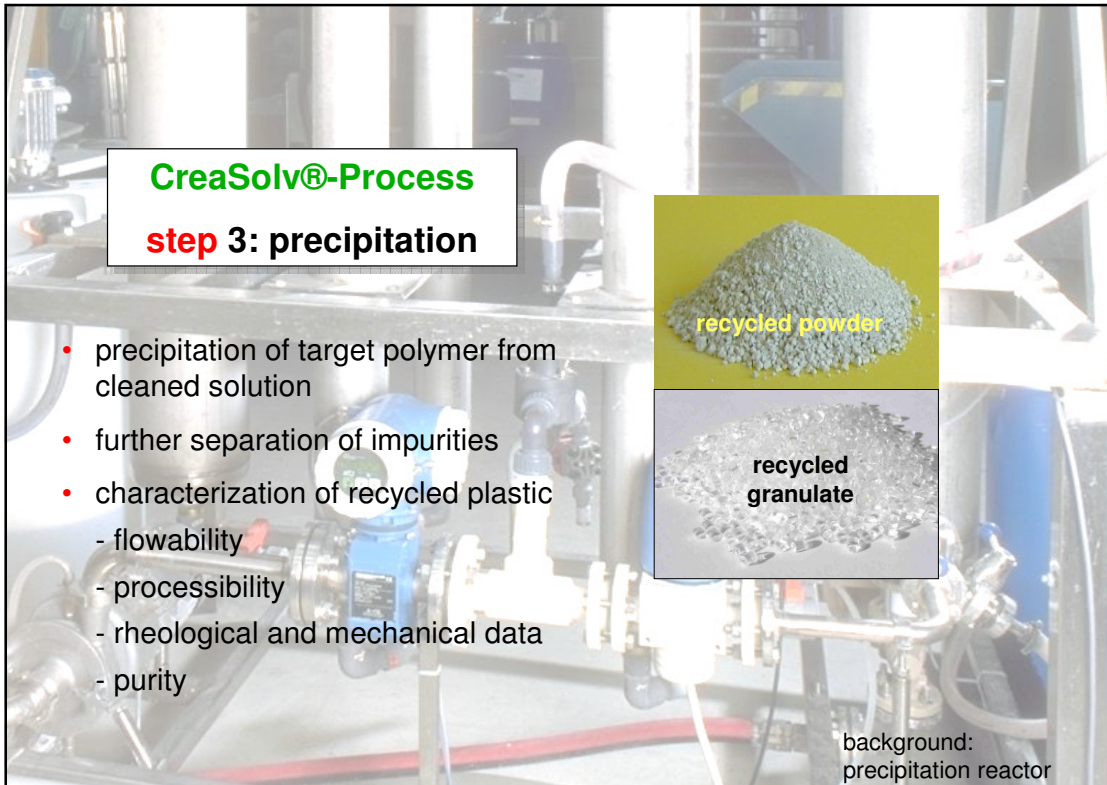


Filter for separation of insoluble impurities




Stage	Percent Reduction
before	100
process 1	45
process 2	10

Reduction of brominated flame retardant content after cleaning.




CreaSolv®-Process
step 3: precipitation

- precipitation of target polymer from cleaned solution
- further separation of impurities
- characterization of recycled plastic
 - flowability
 - processibility
 - rheological and mechanical data
 - purity

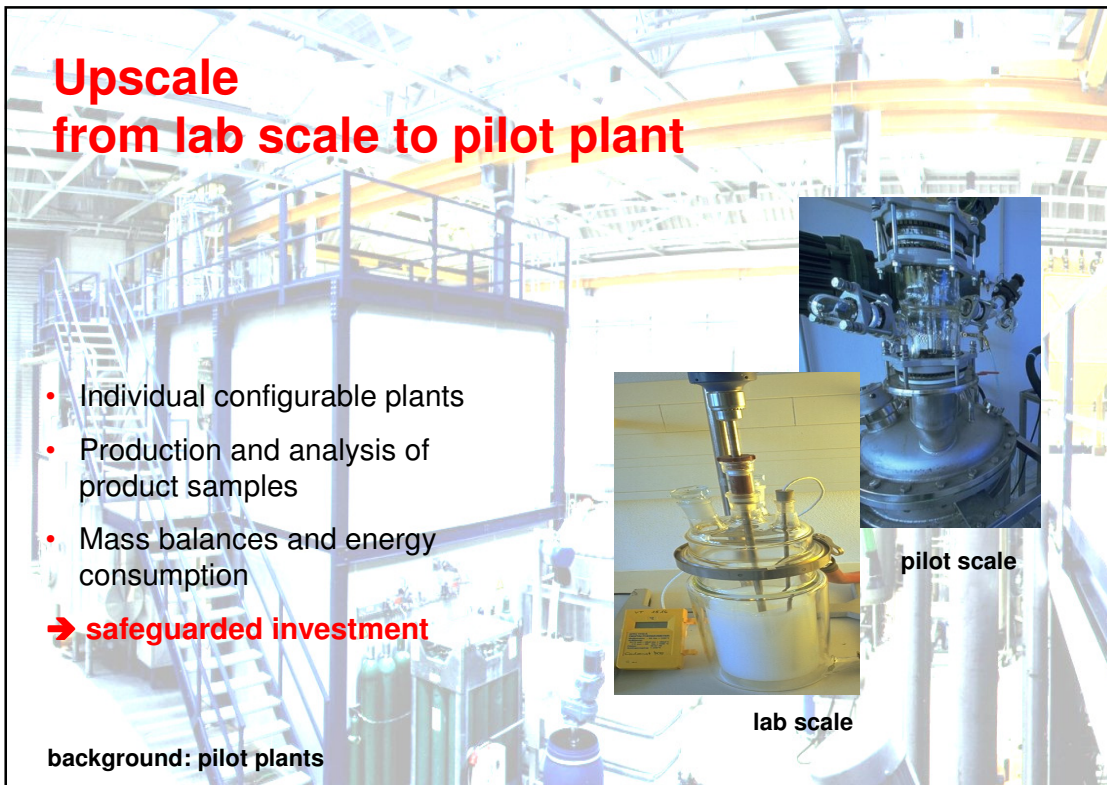


recycled powder



recycled granulate


background:
precipitation reactor



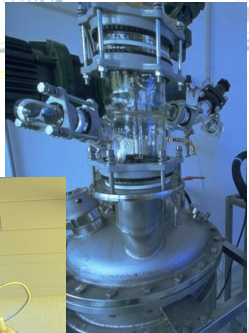
**Upscale
from lab scale to pilot plant**

- Individual configurable plants
- Production and analysis of product samples
- Mass balances and energy consumption

→ **safeguarded investment**



lab scale



pilot scale

background: pilot plants

EPS-Loop: Recycling of EPS-waste

3. EPS-loop project work

- characterization of different input streams
 - development of improved cleaning capabilities
 - dissolving
 - filtration
 - precipitation
 - development of tailored solvent formulations
 - not classified
 - economical internal solvent circulation & recycling
 - sample production and evaluation of different product types
 - granulates
 - expandable polystyrene
- Process development + profitability assessment

EPS-Loop: Recycling of EPS-waste

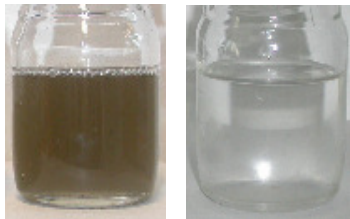
4. Technical results

Filtration

rough



fine

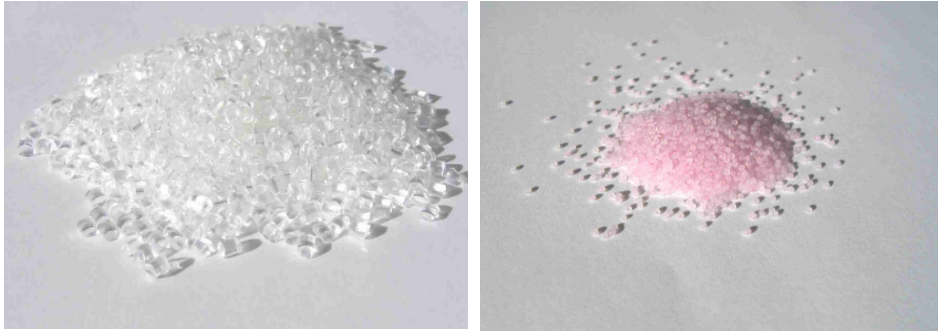


cleaning efficiency

EPS-Loop: Recycling of EPS-waste

4. Technical results

- 100 kg EPS dissolved in 6 batches
 - 100 µm filtering, distillation to higher concentrated PS-solution
- Option A: production of granulate (33% blended with virgin)
- Option B: precipitation of PS-powder (33%), blending with virgin EPS with high content of pentane to produce EPS-beads



EPS-Loop: Recycling of EPS-waste

4. Technical results / product properties

Option A Granulates



Option B

Recycled PS *dry flowable precipitation product*

- Bulk density approx. 0,35 kg/l
- Molecular weight: 96.000 (Mn) or 214.000 (Mw), no degradation after thermo-forming; value within norm/standard
- purity (DSC): Tg= 92 °C (standard PS: 95-100 °C)
- MFR (200 °C, 5 kg): 60 g/10 min (standard PS: 15-20 g/10 min)
- Impact strength (Charpy, notched): < 1,5 kJ/m² (standard: 1,7 kJ/m²)
- Good transparency (visual evaluation)
- Estimated market value: 75% of virgin PS, eg. as MB-carrier

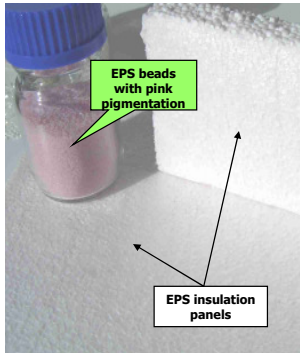
EPS-Loop: Recycling of EPS-waste

4. Technical results / product properties

Evaluation by:



Summary



- Apparent density between 16,9 and 20,5 kg/m³
- Compression strength relatively high with 100 kP
- Thermal conductivity of 0,0366 W/(m·K), negligibly above average value curve

Quality assessment of FIW, München

Acc. to DIN 4108-10 the tested EPS-panels are applicable for:

- Flat roof
- Steep roof
- Wall
- Floor without subsonic noise insulation



EPS-Loop: Recycling of EPS-waste

Summary

Construction of small **Recycling plant at IVV** ✓

Product samples show **high quality** ✓

CreaSolv®-Process (patent and trademark rights)

- produces re-expandable polystyrene
- separates undesired impurities,
- is **raw-material recycling**,
- is **environmental friendly**: liquids are biodegradable, not classified and are recycled within the process.
- is **economical** für EPS.

Realization

Actual Projects for scale up

→ Aim is a process realization with industry partners

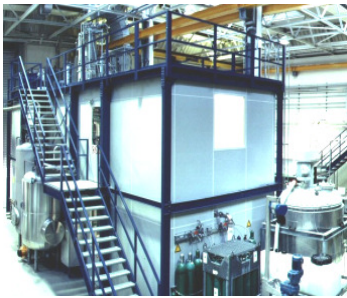
Thanks

- Federal Ministry for Economics and Technology
- Support of innovative networks, InnoNet
- InnoNet management: VDI/VDE, Teltow

EPS-Loop: Recycling of EPS-waste



InnoNet partners:



Pilot plant at Fraunhofer IVV

Project team at Fraunhofer-IVV:

**U. Knauf, A. Mäurer, A. Malberg, O. Beck, A. Möller,
N. Weise, M. Schlummer, L. Gruber, M. Frankl, G. Wolz**

IVV offers the information in this presentation for informational purposes only. Please note that no information in this presentation is provided with the intention of or should be viewed as giving technical advice or instruction. The statements contained in the presentation reflect the results of the quality tests of IVV. They should not be construed as implying a legal guarantee for specific properties of the products or for their suitability for a particular application. IVV assumes no liability or responsibility for any errors or omissions in the content of this presentation. Except as expressly provided, nothing contained in this paragraph shall be construed as conferring any license or right under any IVV copyright. All rights reserved.

The presentation may be used for information purposes only and must not be sold or distributed for commercial or political purposes and the publications must not be modified, reused, reposted or transmitted in any respect.

Information about sites outside of IVV are provided as a help. IVV accepts no responsibility for the content of such sites.